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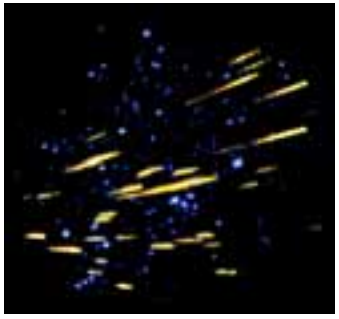
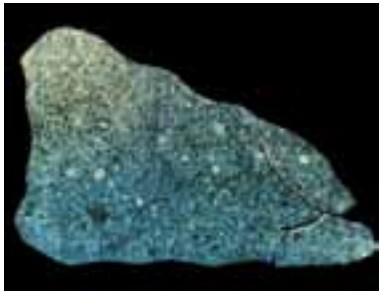
Meteors and Meteorites





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"Shooting stars," or meteors, are bits of interplanetary material falling through Earth's atmosphere and heated to incandescence by friction. These objects are called meteoroids as they are hurtling through space, becoming meteors for the few seconds they streak across the sky and create glowing trails. Chunks of these extraterrestrial visitors that survive their journey through the atmosphere and fall to the ground are called meteorites.

Several meteors per hour can usually be seen on any given night. Sometimes the number increases dramatically — these events are termed meteor showers. Some occur annually or at regular intervals as the Earth passes through the trail of dusty debris left by a comet. Meteor showers are usually named after a star or constellation that is close to where the meteors appear in the sky. Perhaps the most famous are the Perseids, which peak around August 12 every year. Every Perseid meteor is a tiny piece of the comet Swift–Tuttle, which swings by the Sun every 135 years. Other meteor showers and their associated comets are the Leonids (Tempel–Tuttle), the Aquarids and Orionids (Halley), and the Taurids (Encke). Comet dust in meteor showers burns up in the atmosphere before reaching the ground.

Most meteorites are no bigger than an average Earth rock, but some have been quite large, especially in Earth's early history. Large meteorites can cause extensive destruction when they strike. One of the most distinct impact craters is the Barringer Meteor Crater in Arizona, about 1,000 meters (3,300 feet) across. It is only 50,000 years old and so well preserved that it has been used to study impact processes. Since this feature was recognized as an impact crater in the 1920s, about 160 impact craters have been identified on Earth. A very large asteroid impact 65 million years ago, which created the 300-kilometer (180-mile) wide Chicxulub crater on the Yucatán Peninsula, is thought to have contributed to the extinction of about 75 percent of marine and land animals on Earth at the time, including the dinosaurs. Well-documented stories of meteorite-caused injury or death are rare, but in November 1954, Ann Hodges of Sylacauga, Alabama, was severely bruised by a 3.6-kilogram (8-pound) stony meteorite that crashed through her roof.

Meteorites may resemble Earth rocks, but they usually have a "burned" exterior. This fusion crust is formed as the meteorite is melted by friction as it passed through the atmosphere. There are three major types of meteorites: the "irons," the "stones," and the "stony-irons." Although the majority of meteorites that fall to Earth are stony, more of the meteorites that are discovered long after they fall are "irons" — these heavy objects are easier to distinguish from Earth rocks than stony meteorites. Meteorites also fall on other planets. Imagine the excitement when Mars Exploration Rover Opportunity found an iron meteorite on Mars!

More than 30,000 meteorites have been found on Earth. Of these, 99.8 percent are thought to come from asteroids. Evidence for an asteroid origin includes: orbits calculated from photographic observations of meteorite falls project back to the asteroid belt; spectra of several classes of meteorites match those of some asteroid classes; and all but the rare lunar and martian meteorites are very old, 4.5 to 4.6 billion years. However, we can only match one group of meteorites to a specific asteroid. The eucrite, diogenite, and howardite igneous meteorites come from the third largest asteroid, Vesta. Asteroids and the meteorites that fall to Earth are not pieces of a planet that broke apart, but instead the original diverse materials from which the planets formed. The study of meteorites tells us much about the conditions and processes during the formation and earliest history of the solar system.

The remaining 0.2 percent of meteorites is split roughly equally between meteorites from the Moon and Mars. The current 35 known martian meteorites were blasted off Mars by meteoroid impacts. All are igneous rocks crystallized from magma, with distinctive composition indicating martian origin. Controversy continues about whether structures found in the meteorite known as ALH84001 might be evidence of fossil martian bacteria. The 36 lunar meteorites are similar in mineralogy and composition to Apollo Moon rocks, but distinct enough to show that they have come from other parts of the Moon. Studies of lunar and martian meteorites complement studies of Apollo Moon rocks and the robotic exploration of Mars.

SIGNIFICANT DATES

4.55 billion years ago — Formation age of most meteorites, taken to be the age of the solar system.
65 million years ago — Chicxulub impact that leads to the death of dinosaurs and 75 percent of animals on Earth.
50,000 years — Age of Barringer Meteor Crater in Arizona.
1478 BC — First recorded observation of meteors.
1794 AD — Ernst Friedrick Chladni publishes the first book on meteorites.
1908 (Tunguska), 1947 (Sikote Alin), 1969 (Allende and Murchison), 1976 (Jilin) — Important 20th-century meteorite falls.
1969 — Discovery of meteorites in a small area of Antarctica leads to annual expeditions by U.S. and Japanese teams.
1982–1983 — Meteorites from the Moon and Mars are identified in Antarctic collections.
1996 — A team of NASA scientists suggests that martian meteorite ALH 84001 may contain evidence of microfossils from Mars.
2005 — NASA's Mars Exploration Rover Opportunity finds an iron meteorite on Mars.

ABOUT THE IMAGES

1 A basketball-size iron meteorite found on Mars by Opportunity rover.

2 A burst of meteors photographed by NASA Ames Research Center scientists in 1995.

3 The glassy black patches in this martian meteorite contain atmospheric gases.

4 Barringer Meteor Crater in Arizona.

5 A stony meteorite found in Antarctica.

6 A scientist working in the Meteorite Processing Lab at NASA Johnson Space Center.

7 An iron meteorite from Barringer Meteor Crater.

8 A lunar meteorite found in Antarctica similar in composition to lunar rocks brought back by Apollo astronauts.

FOR MORE INFORMATION

solarsystem.nasa.gov/planets/profilecfm?Object=Meteoroids

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